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NOTES ON GEOGRAPHIC DISTRIBUTION

Melanoides tuberculata (Müller, 1774): Northeastern dispersal in the São Francisco Basin, Brazil

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ABSTRACT: *Melanoides tuberculata* (Müller, 1774) (Gastropoda: Thiaridae) is the exotic species with the widest distribution among the freshwater macrobenthos in Brazil. The snail is a threat to native species and has medical and economical importance. In this study the occurrence of *M. tuberculata* is recorded and reported in the São Francisco River Basin, along a border area including three northeastern states of Brazil: Bahia, Sergipe and Alagoas. These data are especially important due to the new watercourses resulting from the integration of the São Francisco River to other regional basins.

Biological invasion occurs when a species colonizes and persists in an area beyond its previous range (Shigesada and Kawasaki 1997). Although bioinvaders can naturally disperse, nowadays most invasions come from human actions, deliberate or accidental (Williamson 1996). The introduction and spread of bioinvaders have generated a global concern owing to the ability of these organisms to alter terrestrial and aquatic environments around the world (Gurevitch and Padilla 2004).

The aquarium trade plays an important role in the dispersal of bioinvaders. A third of the world's worst aquatic invaders are aquarium and ornamental species (Padilla and Williams 2004). This was probably the gateway for the thiarid gastropod *Melanoides tuberculata* (Müller, 1774) (Gastropoda: Thiaridae), introduced in Brazil during the 1960s in São Paulo state (Vaz *et al.* 1986). This Asian-African snail is an intermediate host of human trematode parasites (Madsen and Frandsen 1989; Pinto and Melo 2011).

Since its first record in Brazil, the population has greatly expanded. Nowadays *M. tuberculata* is the exotic species with the widest distribution among the freshwater macrobenthos in the country. Its occurrence reaches nineteen of the twenty-seven Brazilian federal states (Silva and Barros 2011; Souto *et al.* 2011).

Another factor might be contributing to the spread of *M. tuberculata* in Brazil: it is an excellent competitor among benthic mollusks and may eradicate populations of other species that endanger public health. The biological control by competition between *M. tuberculata* snails and planorbids such as *Biomphalaria* spp. has proven to be effective and this is an incentive for its deliberate introduction into natural and artificial water bodies. However, not only are excluded intermediate hosts of schistosomiasis from the community, but the native malacofauna is also threatened by the success of the invader (Pointier and Augustin 1999; Guimaraes *et al.* 2001; Giovanelli *et al.* 2003, 2005).

Melanoides tuberculata is considered an alien species of medical and economical importance by the Brazilian Ministry of Health (Brazil 2007). Recently, parasitic larvae associated to the animal were diagnosed in Brazil for Rio de Janeiro, Minas Gerais and Distrito Federal (Thiengo *et al*. 2007; Pinto and Melo 2010a, b; Paula-Andrade C. *et al.* 2012). Hence, the increased presence of the mollusk in rivers, dams and reservoirs should be treated with great care.

In this study the occurrence of *M. tuberculata* is recorded and reported to the São Francisco River Basin, along a border area including three states of Northeast Brazil: Bahia, Sergipe and Alagoas.

Fieldwork was first carried out at the end of the rainy season in September 2010, then during the dry season in February 2011. The region is located within the Caatinga, one of the major Brazilian biomes characterized by semiarid climate. The basin of the São Francisco River represents one of the most important water resources of Brazil (Brazil 2009).

Snails were collected by hand for an hour on each of the seven stations that were marked by natural water bodies and artificial reservoirs (authorization no. 189/2010-CGFAP). At each station, 800 ml of sediment was also taken for screening and laboratorial analysis. Manual collection and the sediment screening resulted in 26,952 collected specimens (voucher specimens, CMUnB 290 to CMUnB 319) that were deposited in the Malacological Collection of Universidade de Brasília, in Brasília, Distrito Federal, Brazil (Figure 1).

Thiarids in the adult stage have a good resistance to desiccation, surviving a few days up to a month under dry conditions. Desiccation resistance is not a limiting factor for the invasion of thiarids in general, but it limits the invasion of habitats that are more vulnerable to drought such as temporary lakes and ponds (Facon *et al.* 2004). In the study area the analyzed populations survive the severe dry season of Caatinga, despite the collected specimens during this period represent, on average, about 29% of the population accessed during the rainy season (Table 1).

The occurrence of *M. tuberculata* in a border area among the states of Bahia, Sergipe and Alagoas increases the probabilities of the species also be found in Alagoas, which is not yet recorded in scientific papers (Figure 2).

Table 1. Populations accessed at each site during the rainy season and the dry season.

SAMPLING STATION	RAINY SEASON – INDIVIDUALS COLLECTED	DRY SEASON – INDIVIDUALS COLLECTED	GEOPOSITION
1	322	154	09°25'59.86" S; 38°13'43.02" W
2	295	566	09°25'44.26" S; 38°13'28.10" W
3	3495	476	09°52'15.63" S; 37°25'00.76" W
4	1209	690	09°52'56.65" S; 37°43'35.98" W
5	1139	1693	09°58'17.04" S; 37°25'59.60" W
6	12560	2388	10° 04'26.78" S; 37°30'03.21" W
7	1916	49	10° 08'13.87" S; 37°31'55.62" W
TOTAL	**20936**	**6016**	

Figure 1. Shells of *Melanoides tuberculata* (Müller, 1774) collected during the fieldwork (scale bar: 1cm).

These data on geographic distribution are especially important due to the integration of the São Francisco River to the Northeast Watershed (*Projeto de Integração do Rio São Francisco com Bacias Hidrográficas do Nordeste Setentrional)*, a venture of the Federal Government, under the responsibility of the Brazilian Ministry of National Integration. The transposition of tracts of the São Francisco River can lead to changes in the composition of native aquatic communities. According to the official Environmental Impact Report (*Relatório de Impactos Ambientais – RIMA*) the project is characterized by the inevitable mixture of biological communities caused by the introduction of species from one basin to another. This situation mischaracterizes natural ecosystems and may cause loss of biodiversity.

The dispersal of *M. tuberculata* shall be facilitated by the artificial watercourses flowing from the São Francisco River to other basins, endangering the public health and the natural composition of the macrobenthic fauna. Thus, the spread of the species must be constantly monitored and followed with caution.

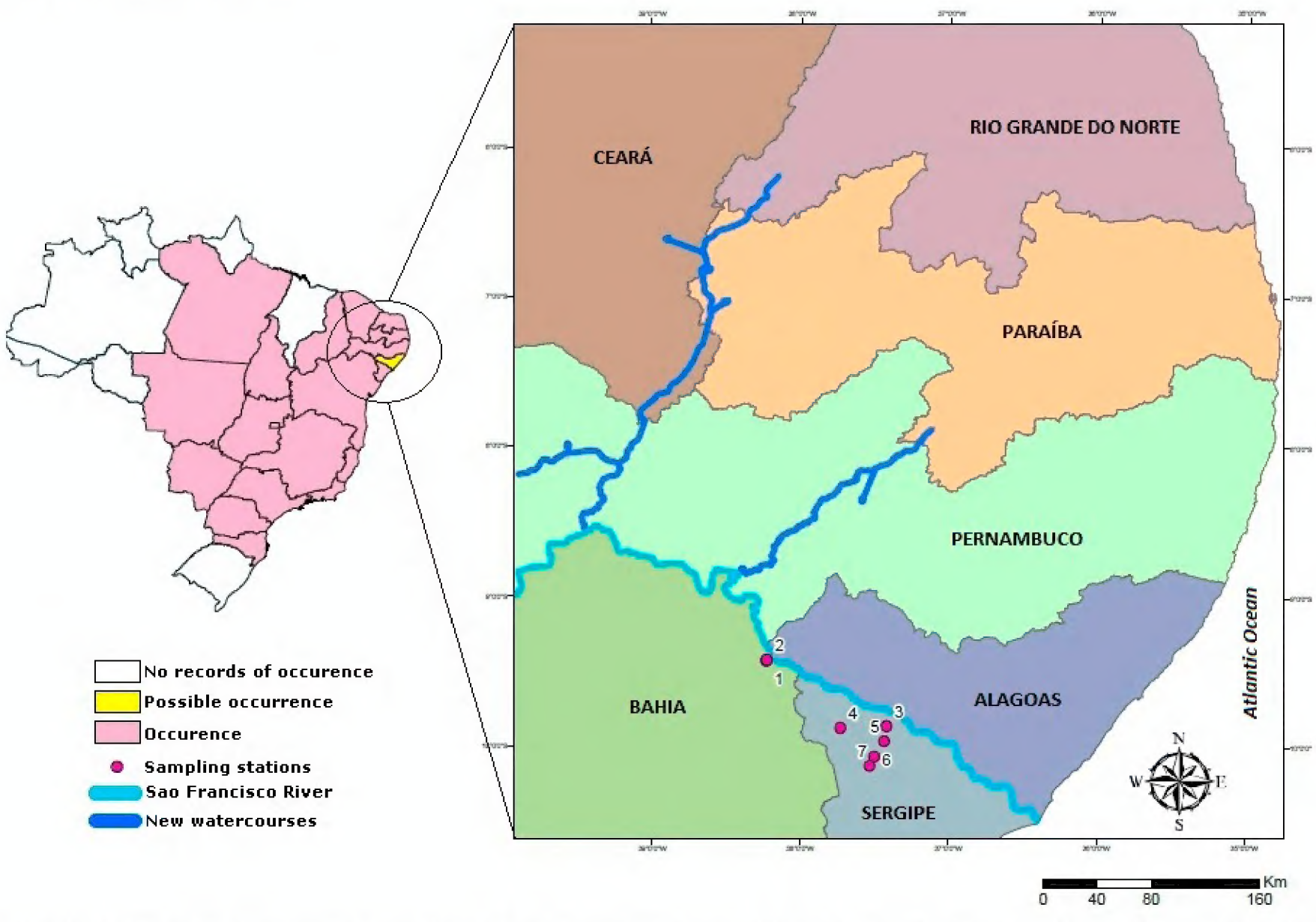

Figure 2. Map of the lower São Francisco region, where the transposition of some tracts of the river is being made, and the sampling stations.

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